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TRANSPORTING DEVICE AND MULTI-CHAMBER APPARATUS HAVING IT

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10	Transporting chamber
11-13	Processing chamber
14	Load lock chamber
20	Loader
30	Transporting device
37a, 37b	Transporting hand
41a-43b	Processing stage

Claims

1. A type of transporting device characterized by the following facts: the transporting device is for transporting workpieces to plural processing chambers; the transporting device has plural supporting units for supporting plural workpieces, respectively; and it can simultaneously transport the plural workpieces into respective processing chambers.

2. A type of multi-chamber apparatus characterized by the following facts: the multi-chamber apparatus has a transporting chamber and plural processing chambers which are installed adjacent to the transporting chamber and perform different processings for workpieces; a transporting means for supporting plural workpieces and, at the same time, transporting the workpieces into said processing chambers, respectively, is installed in said transporting chamber; in each processing chamber, plural processing stages for supporting plural workpieces are set.

3. The multi-chamber apparatus described in Claim 2, characterized by the fact that said transporting means support the plural workpieces with the workpieces installed in a horizontal configuration or vertical configuration with respect to each other, and the processing stages in said processing chambers support the plural workpieces corresponding to the transporting state in said transporting means.

4. The multi-chamber apparatus described in Claim 2 or 3, characterized by the fact that said plural processing chambers perform the same processing for the plural workpieces.

5. The multi-chamber apparatus described in Claim 2, 3 or 4, characterized by the fact that in each of said processing chambers, there is a partition member that divides the processing chamber into plural portions corresponding to the plural workpieces, respectively.

6. The multi-chamber apparatus described in Claim 2, 3, 4 or 5, characterized by the fact that said transporting means supports two workpieces, and, at the same time, transports two workpieces to the respective processing chambers.

Detailed explanation of the invention

[0001]

Industrial application field

This invention pertains to technology for a type of multi-chamber apparatus characterized by the fact that it has plural processing chambers for sputtering or other processing of semiconductor wafers.

[0002]

Prior art

When thin films for wiring are formed on semiconductor wafers (hereinafter referred to as wafers) by sputtering, in order to increase the throughput and to enable formation of laminated films in a single operation, a type of multi-chamber apparatus is used, such as that described in Press Journal K.K.: "Monthly Semiconductor World," February 1993, published January 20, 1993, pp. 30-34. In this multi-chamber apparatus, plural sputtering processing chambers are installed around a transport chamber at the center.

[0003]

For a multi-chamber apparatus, in order to solve the problem of cross contamination that usually takes place when various processings are performed in a single processing chamber, only one type of processing is carried out in each processing chamber, and each processing chamber has its independent evacuating system. Consequently, the number of processing chambers is large, the number of pumps is increased, and the evacuating system becomes complicated. Consequently, the price of the apparatus is boosted. Also, a larger clean room is needed for installation.

[0004]

Problems to be solved by the invention

In a multi-chamber apparatus, processing chambers for performing processing under different conditions are installed around a transporting chamber known as a transfer chamber or buffer chamber, and wafers are transported sequentially to the processing chambers for plural processes. As wafers are transported to [the various] chambers, respectively, the final processed wafer is taken from the last processing chamber, and a wafer from the processing chamber for a preceding step of operation is transported into the processing chamber of a later step of operation. At the same time, a new wafer is carried from the load lock chamber into the initial processing chamber.

[0005]

Consequently, when wafers are transported, while a new wafer is carried into the initial processing chamber, wafers in later processing chambers should be shifted. Consequently, the time needed for transporting wafers becomes longer than the time needed for processing in each processing chamber. That is, the overall throughput of the multi-chamber apparatus depends not only the processing times in the various processing chambers, but on the transporting times of wafers into the various processing chambers.

[0006]

The objective of this invention is to improve the processability and to increase the throughput of processing of a multi-chamber apparatus.

[0007]

The aforementioned objective and other objectives as well as the novel characteristics of this invention will be explained in the text and figures of this specification.

[0008]

Means to solve the problems

The following is a brief account of the typical features of the invention disclosed in this patent application.

[0009]

This invention provides a type of transporting device characterized by the fact that the transporting device has plural supporting units for supporting plural workpieces, respectively, and it can simultaneously transport the plural workpieces into respective processing chambers.

[0010]

Also, this invention provides a type of multi-chamber apparatus characterized by the following facts: a transporting means for supporting plural workpieces and, at the same time, transporting the workpieces into said processing chambers, respectively, is installed in said transporting chamber; in each processing chamber, plural processing stages for supporting plural workpieces are installed.

[0011]

Each processing chamber performs the same processing for the plural workpieces. The workpieces are transported and supported on the processing stages in each processing chamber when they are installed in a horizontal or vertical configuration. In each of said processing chambers, there is a partition member that divides the processing chamber into plural portions corresponding to the plural workpieces, respectively. Said transporting means supports two workpieces, and, at the same time, transports two workpieces to the respective processing chambers.

[0012]

Operation of the invention

By means of a transporting device having the aforementioned configuration, it is possible to transport plural workpieces in processing chambers. Consequently, the transporting efficiency can be increased.

[0013]

In the multi-chamber apparatus, plural processing stages are installed in each of the plural processing chambers installed adjacent to the transporting chamber. By simultaneously transporting plural workpieces using the transporting means to the respective processing stages, it is possible to increase the processing efficiency significantly.

[0014]

Also, it is possible to transport the plural workpieces while they are installed in a horizontal configuration or vertical configuration. This may be freely selected corresponding to the installation sites of the multi-chamber apparatus.

[0015]

Application examples

In the following, this invention will be explained in more detail with reference to application examples illustrated by figures.

[0016]

Figure 1 is a plan view illustrating a multi-chamber apparatus in an application example of this invention. It has three processing chambers, namely, first processing chamber (11), second processing chamber (12) and third processing chamber (13), and load lock chamber (14) installed around transporting chamber (10). Gate valves (15)-(18) are installed between processing chambers (11)-(13) as well as load lock chamber (14) and transporting chamber (10), so that they can be connected to each other or closed from each other at will.

[0017]

Loader (20) is installed via gate valve (19) on load lock chamber (14). On said loader (20), two carrier fixtures (21a) and (21b) are installed. The wafers accommodated in carrier fixtures (21a) and (21b) are transported to preheating stages (22a) and (22b) installed in load lock chamber (14) by means of transporting arms (23a) and (23b) on loader (20).

[0018]

In transporting chamber (10), transporting device (30) is installed so as to transport the wafers sequentially to three processing chambers (11)-(13) after carrying them from preheating stages (22a) and (22b) in load lock chamber (14) into transporting chamber (10).

[0019]

In said transporting device (30), there is rotating table (32) which rotates around rotating shaft (31) extending in approximately the vertical direction. Driving arms (34) are mounted on two transporting shafts (33) mounted on said rotating table (32). Transporting arms (35) are engaged by pins on said driving arms (34), respectively. These transporting arms (35) are engaged by pins on supporting table (36). On said supporting table (36), transporting hands (37a) and (37b) for supporting wafers are mounted as supporting units.

[0020]

Said transporting device (30) can rotate rotating table (32) around rotating shaft (31) so as to install transporting hands (37a) and (37b) into positions facing said three processing chambers (11)-(13) and load lock chamber (14). Also, when at least one of two transporting shafts (33) is driven, transporting hands (37a) and (37b) are driven to move forward or backward via driving arms (34) and transporting arms (35).

[0021]

In each of processing chambers (11)-(13), two of processing stages (41a)-(43b) are installed, respectively. On these processing stages, processing electrodes not shown in the figure are mounted. Also, in said processing chambers (11)-(13), partition plates (44)-(46) are installed, respectively, to divide each processing chamber into two processing stages, so that when two wafers are processed at the same time in each processing chamber (11)-(13), cross contamination can be prevented.

[0022]

In the following, the procedure for wafer sputtering by the aforementioned multi-chamber apparatus having said transporting device (30) will be explained. The two wafers accommodated in carrier fixtures (21a) and (21b) are transported by transporting arms (23a) and (23b) into load lock chamber (14) at atmospheric conditions, and they are carried on preheating stages (22a) and (22b), respectively. Then, gate valve (19) is closed, and load lock chamber (14) is evacuated by a vacuum pump not shown in the figure. Then, gate valve (18) is opened.

[0023]

In this state, transporting device (30) is driven, and, with its rotating table (32) at the rotating position shown in Figure 1, driving shafts (33) are driven, so that two transporting hands (37a) and (37b) are driven to move forward. In this way, the wafers on preheating stages (22a) and (22b) within load lock chamber (14) are grasped by transporting hands (37a) and (37b), and the wafers are carried into transporting chamber (10). Then, gate valve (18) is closed.

[0024]

Then, as rotating table (32) is rotated by 90° clockwise as shown in Figure 1, three [sic; two] transporting hands (37a) and (37b) are installed into the position facing processing chamber (11). In this state, gate valve (15) is opened, and transporting hands (37a) and (37b) are driven forward, so that the wafers are transported to processing stages (41a) and (41b), respectively. After transport, gate valve (15) is closed, and sputtering is performed at said processing stages (41a) and (41b), respectively. In this case, partition plate (44) is installed between the two processing stages (41a) and (41b), so cross contamination can be prevented.

[0025]

After the end of processing in first processing chamber (11), the wafers are transported sequentially to the other processing chambers (12) and (13), and, in total, three types of processing are carried out under different conditions. Then, they are carried through load lock chamber (14) to carrier fixtures (21a) and (21b). In this way, a series of processing steps come to an end.

[0026]

In this way, in the case illustrated in the figure, two wafers are processed simultaneously in each of processing chambers (11)-(13). Consequently, it is possible to double the processability, that is, throughput, without significantly enlarging the area occupied by the apparatus.

[0027]

As explained in the above, two transporting hands (37a) and (37b) are installed on supporting table (36) of transporting device (30). When the multi-chamber apparatus is assembled in this case, it is preferred that the positions of the sample tables in the processing stages within processing chambers (11)-(13) be finely adjusted corresponding to assembly variation of transporting device (30).

[0028]

Figure 2 is a cross-sectional view illustrating a portion of processing chamber (11). It illustrates the mechanism of fine adjustment of sample tables (51a) and (51b) that form processing stages (41a) and (41b). The same structure is adopted in the other processing chambers (12) and (13).

[0029]

Sample tables (51a) and (51b) that support wafers W are mounted using hollow supporting shafts (52a) and (52b), respectively, in a freely movable manner in the horizontal direction. That is, they can move freely in the direction indicated by X shown in Figure 2 and in the direction of the Y axis at a right angle to this. On sample tables (51a) and (51b), free deformable bellows (53a) and (53b) are installed, respectively. They are used to isolate processing chamber (11) from the outside.

[0030]

Lift shafts (54a) and (54b) are fit in hollow supporting shafts (52a) and (52b), respectively. On the tips of lift shafts (54a) and (54b), lift pins (55a) and (55b) are installed, respectively, to move wafers vertically when mounting them on sample tables (51a) and (51b) or when removing them from sample tables (51a) and (51b).

[0031]

When sputtering is carried out in processing chambers (11)-(13), a target material, a cathode and an anode are installed inside each processing chamber. On the other hand, when dry etching is performed, electrodes for generating reactive gas plasma are assembled.

[0032]

Figure 3 is a front cross-sectional view indicating a portion of a multi-chamber apparatus in another application example of this invention. Different from the aforementioned application example, in which two wafers are installed on the same plane for transporting and processing, in the case shown in Figure 3, two wafers are installed above and below, respectively, for transporting and processing.

[0033]

As shown in the figure, transporting device (30) has two transporting hands (37a) and (37b) installed above and below, respectively. Just as in the case shown in Figure 1, driving is performed by transporting device (30) having driving arms (34) and transporting arms (35).

[0034]

On the other hand, sample tables (41a) and (41b) are installed as two stages, an upper stage and a lower stage, respectively, corresponding to transporting hands (37a) and (37b) in processing chamber (11). In this case, it is possible to reduce the space, that is, the installation area, of processing chambers (11)-(13) in the horizontal direction.

[0035]

In the following, this invention will be explained in more detail with reference to the application examples. Of course, this invention is not limited to the aforementioned application examples. As long as the main points are observed, various changes can be made.

[0036]

For example, although there are three processing chambers shown in the figures, the number is not limited to three. Any number can be adopted. Also, in the case shown in the figures, two wafers are simultaneously transported and processed as workpieces. However, it is also possible to simultaneously transport and process three or more workpieces.

[0037]

The above explanation has been made with reference to sputtering as an application field of this invention by the present inventors. However, the application is not limited to this. It may also be applied in any other cases of semiconductor manufacturing apparatus having processing chambers, such as CVD processing and etching processing.

[0038]

Effect of the invention

The following is a brief account of the typical effects that can be realized by the invention disclosed in this patent application.

[0039]

(1) Plural workpieces are supported by the transporting device and are transported into plural processing chambers. Consequently, the transporting efficiency of the workpieces is significantly increased.

[0040]

(2) Plural workpieces transported by the transporting device are simultaneously processed in the processing chambers. Consequently, the processability is significantly improved.

[0041]

(3) In this way, it is possible to significantly increase the throughput of the workpieces without significantly increasing the area occupied by the apparatus.

Brief description of the figures

Figure 1 is a plan view illustrating a multi-chamber apparatus in an application example of this invention.

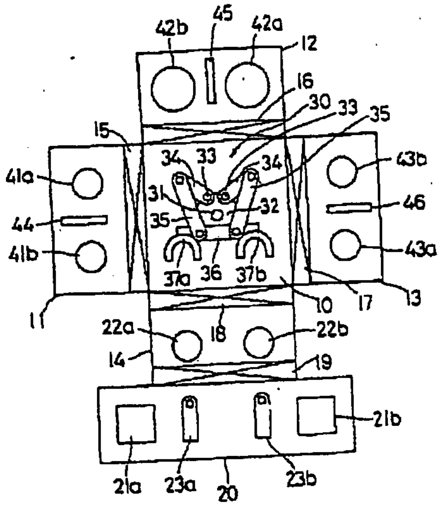
Figure 2 is a front cross-sectional view illustrating the main portion of Figure 1.

Figure 3 is a front cross-sectional view illustrating a portion of a multi-chamber apparatus in another application example of this invention.

Explanation of symbols

10	Transporting chamber
11-13	Processing chamber
14	Load lock chamber
15-19	Gate valve
20	Loader
21a, 21b	Carrier fixture
22a, 22b	Preheating stage
23a, 23b	Transporting arm
30	Transporting device
31	Rotating shaft
32	Rotating table
33	Driving shaft
34	Driving arm
35	Transporting arm
36	Supporting table

37a, 37b	Transporting hand
41a-43b	Processing stage
44-46	Partition plate
51a, 51b	Sample table
52a, 52b	Hollow supporting shaft
53a, 53b	Bellows
54a, 54b	Lift shaft
55a, 55b	Soft [sic; lift] pin



１０：搬送室
１１～１３：処理室
１４：ロードロック室
２０：ローダ
３０：搬送装置
３７ａ、３７ｂ：搬送用ハンド
４１ａ～４３ｂ：処理ステージ

Figure 1

10	Transporting chamber
11-13	Processing chamber
14	Load lock chamber
20	Loader
30	Transporting device
37a, 37b	Transporting hand
41a-43b	Processing stage

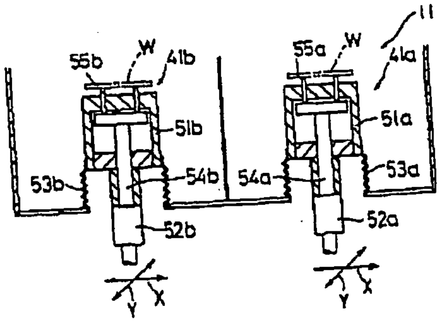


Figure 2

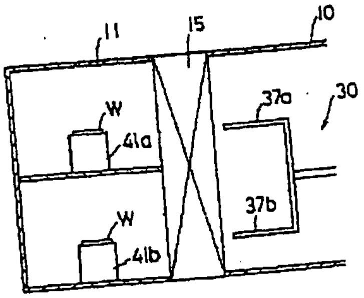


Figure 3